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DRAINAGE MODIFICATIONS IN KNOX, LICKING
AND COSHOCTON COUNTIES.¹

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It is not intended in this article to discuss the whole drainage system of these three counties, or even that of any one of them. The area to be studied may be bounded roughly by the triangle whose vertices are located at Newark, Mt. Vernon and Coshocton. This territory is entirely within the hydrographic basin of the Muskingum and practically all its drainage is carried to that river by three streams.

The largest of these three streams is the Walhonding River which, with its upper continuation, Owl Creek, flows along the northern side of the triangle outlined above. This drainage axis is the outlet for all the northwestern and northern portions of the region under consideration. In addition, the Walhonding receives very considerable contributions from the North, chiefly by way of Mohican and Kilbuck Creeks. With the exception of the lower part of the former, these two creeks were not studied in this investigation.

South of the Walhonding is Wakatomaka Creek, second in order of the three streams indicated above not only in location but in size as well. The axis of this creek takes a general southeasterly direction through the heart of the area under review. It drains, perhaps, rather more than a third of the triangle.

Lastly, the Rocky Fork is a small creek confined almost exclusively to the northeastern part of Licking County, and draining quite approximately that whole section of the county, an exception being found along the extreme eastern border which is drained by the Wakatomaka.

A clearer idea of the relations of these streams may be had

¹ Presented to the Department of Geology and Botany of Denison University as a Thesis in pursuing work for the degree of Master of Science.

by referring to Plate I., which is a sketched map of the drainage whose central outlines have just been indicated. Even a casual study of this map can hardly fail to reveal peculiarities in the drainage which it represents. Perhaps the first of these to catch the eye is the fact that the North Fork of the Licking receives no tributaries from the East, all the water that might be expected to come into it from that direction flowing off by way of the smaller and more tortuous Rocky Fork, which rises almost in the valley of the North Fork. Again, Owl Creek leads into a roundabout course some drainage that one might reasonably suppose ought to come down into the North Fork. This supposition is all the more rational when it is known that the headwaters of both Owl Creek and the North Fork are in the same preglacial valley. Another strange feature is the irregularity of the Wakatomaka system. Although its axis maintains a generally southeasterly direction, the main stream itself is extremely tortuous and its tributaries preserve nothing like normal parallelism.

Having noted some of these peculiarities it will not be out of place next to outline briefly the map study which served as a preliminary to the field study. The working hypotheses with which we entered the field were based upon this map study in connection with the work already done by Professor Tight in adjacent regions to the South and Northwest. Indeed it will readily be understood by those who have followed the investigation upon glacial stream-modification in Ohio that the work in this region was undertaken with the idea of correlating changes found here with those already worked out in adjoining territory.

Some years ago, while engaged on his researches in the neighborhood of Hanover and the Licking Gorge¹, Professor Tight had noticed a rather large preglacial valley tributary to what he has called the Old Newark River. This old tributary came seemingly from the Northeast and entered the main valley at a point nearly opposite Hanover. But at present it brings

¹ TIGHT, W. G., Bull. Sci. Lab. Den. Univ., 8²:35-63, 1894.

into the valley no stream larger than a wet weather run. Lack of time forbade exploration of this old tributary and the determination of the area formerly drained by it was left as a problem for the future. Later, when eroded cols had been located above Walhonding on Owl and Mohican Creeks it was felt that the mouth of the Walhonding was too far east to have been the outlet for the middle basin of that stream in a normal system of drainage. So after map study it was concluded that the most probable outlet for this middle portion of the Walhonding (possibly including Kilbuck Creek also) was by way of an axis following West of South and emptying into the Old Newark River as the tributary whose mouth had been already observed opposite Hanover. At the same time the possibility of this section of the Walhonding having gone out to the West, passing somewhere near Bladensburg, was noted and discussed. (In this case it would have emptied into the Old Mt. Vernon River, a pre-glacial stream located by Professor Tight in the course of some work the result of which has not yet been published. Its location may be noted on Plates II. and III.)

Passing next to the Wakatomaka, it was thought that an eroded col would probably be found somewhere near the point where this creek crosses the line between Knox and Licking Counties. In this case all the upper waters of this stream would have gone originally West or Northwest into the Old Mt. Vernon River, while its middle course would have been crossed at some point by the preglacial stream emptying opposite Hanover. And its lower waters would have entered the Old Newark Valley, as at present, near Frazeyburg. Reference to Plate II. will make clear the fact that the Wakatomaka in that portion of its course between Frazeyburg and Dresden is now flowing up the valley of the Old Newark River. This reversal, as has been pointed out by Professor Tight's work¹, being due to the glacial dam at Hanover. Hereafter the stream which formerly occupied the old valley opening opposite Hanover will be called the Old Hanover Creek. Whether that

¹ TIGHT, W. G., Bull. Sci. Lab. Den. Univ., 8²:35-63, 1894.

portion of the Wakatomaka which lies so nearly coincident with the boundary between Licking and Coshocton Counties formerly constituted a part of the main axis of the Old Hanover Creek or whether the tributary which parallels this portion of the creek about two miles further to the East may have previously received its headwaters from further North, and hence have been the main line of drainage, was left an open question for the field work to settle.

Finally, with regard to the Rocky Fork, it seemed quite evident that from the point where that stream turns South its upper waters must, in preglacial times, have flowed either northwest into the Old Mt. Vernon River or southwest into the North Fork. They may have even been divided, portions going into each basin. In how far these hypotheses accorded with the facts is now to be seen. As the field work had to be done on Saturdays and during brief two- and three-day recesses in regular school work I found it impossible to make a strictly consecutive study of the whole area. Consequently the single-day periods were utilized for working up that portion of the region which was near at hand, while more distant sections were reserved for times when trips of a few days length would make visits to them more profitable.—All of which is to explain why no attempt will be made to present the facts in the order in which they were gathered and studied.

As it was at first deemed that the location of the preglacial Walhonding would have an important bearing upon the settlement of minor modifications in its locality, that part of the subject will be taken up first. After preliminary trips, one up the Walhonding from Coshocton to some four miles above Warsaw, the other up the Old Hanover Creek, it was decided that the most economical as well as the surest method would be to traverse the present water shed extending from Coshocton westward between Wakatomaka and the Walhonding. Such a trip was taken in company with Professor Tight and resulted in demonstrating that the water shed referred to is a rock ridge throughout its whole length and contains no gaps sufficient either in width or depth to have ever carried even a small part

of the Walhonding drainage. Of course there are the usual indications of piracy from one side of the ridge to the other, but only very limited areas are affected by any of these cases. Many of these piratical modifications, however, are of sufficient magnitude and local interest to repay well the time that would be required to work them out carefully. The discovery of the high and unbroken character of the ridge between these two streams demolished what had been considered the most important of our working hypotheses. However the fact had been demonstrated beyond a peradventure, so a new turn was taken and the possibility observed that perhaps one of the two cols that had been located on Owl and Mohican Creeks had not been based on sufficient data. Professor Tight had located these cols some two years previously, and in order that the work might be reviewed with as little bias as possible, it was decided that the writer, who had not been on the ground before, should make a trip into that region. Professor Tight suggested in a letter that probably no eroded col would be found on the Mohican. The writer's opinion was that none would be established on Owl Creek. In the sequel it was demonstrated that both suggestions were untenable and the original inferences the only ones that could be supported by the evidences of the field. Leaving the old Mt. Vernon River at the little village of Howard, Owl Creek enters the mouth of a pre-glacial valley which gradually narrows and whose rock floor gradually rises as Millwood is approached. In the lower portion of this valley its floor is covered to an undetermined depth with bowlder clay, and at a point a mile or such a matter from Howard the valley is filled more than half way across with a heap of morainic material rising 50 feet or more above the level of the present valley floor. As one approaches Millwood the glacial drift thins out so that there is left but a comparatively shallow stratum of soil on the rock floor of the old valley, and the creek itself has cut a gorge into this rock floor. The maximum depth attained by this gorge probably does not exceed 40 feet. This maximum depth of gorge, accompanying the maximum elevation of the old rock floor, occurs perhaps a mile East of Millwood. From

this point eastward the valley widens and deepens again. Very soon it begins to fill again with deposited material, probably the most of it carried in by the glacial stream. Two miles above the junction with Mohican marked terraces are seen. At a point rather less than two miles above the junction of the two streams a somewhat startling narrowing of the valley was noted, but a careful examination failed to reveal any decided signs of an eroded col. And under the circumstances of the col further up stream it would require very convincing evidence before I would locate an old col at this point.

As one comes down into the valley of the Walhonding it is at once evident that the lower part of Owl Creek, that part below the Milwood col, and the Walhonding, originally formed a single continuous axis, to which the drainage brought in by what is now the lower portion of the Mohican made only a very inconsiderable addition. Now the last named stream probably brings in more water than Owl Creek. At the point of junction and for a considerable distance up stream from that place the valley of the Mohican is deep and narrow with quite steep walls and a tortuous course—all the indications of an insignificant pre-glacial existence. In another place we have the observation that this character is entirely lost in the upper portions of the stream where it is flowing in the valley of the Old Mt. Vernon River.

From its formation to Coshocton, a distance of some 20 miles, the Walhonding winds about on the flood plain of an old pre-glacial valley. Rock cliffs all along this valley, showing where long points between tributary hollows and ravines have been cut away, may be due in part to a recent period of rapid erosion as by the action of glacial waters, and in part to the ordinary phenomena of stream action. Throughout the whole distance from the junction of Owl and Mohican Creeks to Coshocton there is not the sign of a gorge to indicate the possibility of an eroded col. At no place is the Walhonding flowing on rock bottom where such rock bottom represents the maximum depth of the pre-glacial drainage for that immediate section of the valley. And if we restore the cols on Owl

and Mohican Creeks, together with another located by Professor Tight near Millersburg on Kilbuck Creek, the hydrographic basin of the Walhonding would be completely rock bound except at the point where it opens into the valley of the Muskingum at Coshocton. Our only possible conclusion, therefore, is that the pre-glacial Walhonding must have emptied its waters into the Old Newark River at the point where it now empties into the Muskingum.

The filling of the Walhonding Valley has probably resulted from both stream deposition and glacial advance up the valley. Exposures in the upper part of the valley where the Toledo and Walhonding Valley R. R. has cut through the terraces show very distinct shingling. But down at Warsaw, there is a dam some 25 or 30 feet high and a few hundred feet broad which almost completely fills the mouth of Beaver Run. I was able to find no very new exposures along this dam at the time of my visit and could discover no evidences either of shingling or of heterogeneous deposition. A plan of the fill did not seem to me to present a sufficiently rounded outline to have been deposited from an eddy, which from its position out of the main current is the only way in which it could have been deposited by water. Its relatively straight contours on both the up and down stream sides indicate that it may be a lateral moraine from a tongue of ice pushed up the valley. And its pebbles and boulders are glacier-worn.

Kilbuck Creek, which empties about two miles below Warsaw, is the Walhonding's chief tributary. As one looks into it on coming up the latter stream it presents a wide open valley comparable in size with that of the Walhonding itself. The lower portion of the stream has not been carefully studied in this connection but reference has already been made to the fact of Professor Tight's having located an eroded col near Millersburg. This old col was but a few miles North of the Coshocton County line, hence the Old Kilbuck and Walhonding Creeks must have drained approximately equal areas. This readily explains the nearly equal sizes of their valleys, while the increased volume of water now coming in from Owl and Mohican

Creeks as against the small amount coming from above the Old Millersburg col furnishes a very acceptable reason for the present disparity in volume of water carried by the two valleys. Most of the topographical features mentioned above have been indicated on the map (Plate II.) showing the old drainage as modified into the new. It is to be noted that the heavy lines representing the pre-glacial valley walls are drawn to indicate the tops of those walls, not their bases.

It has already been mentioned that a preliminary trip was taken up the old Hanover valley. The results of that trip will now be discussed somewhat more in detail. The floor of this old valley, which is a continuation of the Hanover morainic dam, is rolling and more or less cut up by small ravines. Very soon after entering its mouth the drainage is found to be flowing up the valley away from the old main stream. About two and a half miles from the valley's mouth there is another morainic dam rising some fifty feet above the bed of the run. But this obstacle has not been of sufficient elevation to turn the water back over the Hanover dam. The run has made its cut at the junction between deposited material and the old valley wall (west side), so that one side of the gorge is rock and the other morainic material. East of this point the dam slopes down somewhat rapidly to the level of the stream bed again, so that for a distance of two miles further to its junction with the Wakatomaka, near the county line, the run is little more than a ditch winding through the fields and having a very sluggish current. Wakatomaka comes down the drift-filled valley as a much larger stream, but has the same characteristics of a winding bed and sluggish current. Instead of flowing on down the old valley to the Licking, however, the Hanover dam has been high enough to force the waters over a low col in the north-western corner of Muskingum county, and thus allow them to escape by another route into the Old Newark river. At Frazeysburg they turn up this old river valley (the eastward prolongation of the Hanover dam again prevents them from flowing down the old course) and continue sluggishly to the Muskingum at Dresden. Reference has already been made to Pro-

fessor Tight's previous publication concerning this last mentioned feature of the Wakatomaka's lower course.

Returning to the point where Wakatomaka creek crosses the Licking county line, we will ascend the old valley to the mouth of its principal tributary, Winding Paddy's Fork. At this place it is evident, both from the position and the relative sizes of the two valleys, that the tributary now occupies what was originally the main valley, while the principal stream comes into this valley through what was at one time only a tributary valley. Trips up Winding Paddy's Fork and around its headwaters both demonstrate that it heads normally in the high rock divide. The regular fan-like phenomenon of its head ravines gave rise to some speculation at first, but careful examination indicates that the peculiarity had been wrought by local topographic features and has had no direct bearing on other parts of the problem. From map study we had thought possibly this phenomenon might be due to glacial constriction of a system more widely distributed in former times. But an examination in the field proved the fan to be rock-bound, except at the one point where its waters make their exit into the above named Fork.

Going back now to the Wakatomaka and ascending that stream, we soon find it entering a deep, rocky gorge. On one trip, in descending into the gorge from the high divide on the south, the barometer showed a drop of nearly 400 feet in advancing no more than a quarter of a mile. The cutting is so deep here as to have extended for two or three miles along the stream, hence it is impossible to locate the exact position of the eroded col. It may have been between any one of a half dozen or more pairs of hill tops. But this inability to locate it exactly does not vitiate the proof that a col once existed somewhere along the course of this gorge; for, besides the evident newness of this section of the channel, as compared with sections above and below, this is the farthest up-stream section in which the water is found flowing on rock bottom. Above the gorge the valley widens out until it finally opens, at Bladensburg, into an old pre-glacial valley whose axis lies

nearly due east and west. This Bladensburg valley was the main axis of a small stream, tributary to the old Mt. Vernon river, to which reference has already been made. It is evident that the waters which cut out this old valley flowed toward the West because to the East it heads in the rock divide, then widens and deepens (so far as the rock floor is concerned) toward the West. It was in one of the southern tributaries of this valley that a col was cut down in opening up the new gorge of the Wakatomaka. The filling in this Old Bladensburg Valley is so deep that the tops of the hills immediately bordering the pre-glacial main valley have been entirely covered, and the present appearance is that of a great valley whose sides are the divides bordering the hydrographic basin of the old stream. The appearance of greatness is so deceptive that when we first came upon the view we were sure that we had found the long sought-for outlet of the middle Walhonding. But when we found it heading out in the highest rock divide in this part of the state, and saw, furthermore, that the present floor of the valley is very high as compared with other valleys in the region, we revised our conclusions and decided that its present great width is due to the tremendous filling that it has undergone. This filling consists of the usual deposits found in the glaciated portions of the state—irregularly deposited boulder clay of varying depth and composition. The floor of the valley as now filled up is not level but is rolling with here and there considerable heaps of material as though left by icebergs stranded on some point of rock higher than its neighbors. At the same time the whole region is so completely covered with the debris that it would seem as though the bulk of the deposition must have resulted from the advance of the ice sheet into the valley and all its tributaries. It is to be noted also that this filling of the Old Bladensburg Valley extends up to the very top of the divide separating this drainage from that of the Walhonding. But this is a feature that will be referred to later in another connection.

A clearer view of the Wakatomaka modifications, as well as their relation to the Walhonding system, may be had from a

study of the map (Plate II.) already referred to in connection with the modifications in the latter stream.

In view of the preceding descriptions the changes sketched in the Rocky Fork region will be self-explanatory. Notice that as usual in all this part of the state the mouths of westward flowing streams have been blocked up by the glacial debris until their waters were forced over low cols into adjoining systems, with the final result that new streams were located having their axes at right angles to those of the old streams, but utilizing parts of the old valleys, along with some of their tributaries. It will be seen that Rocky Fork occupies parts of the main valleys and tributaries of two westward flowing pre-glacial streams as well as that of an insignificant tributary to the Old Newark River. It now takes practically all the drainage that formerly came to the North Fork of the Licking from the East by way of the two streams, one of whose axes it follows in a reversed direction, and the other of which, after following for a few miles, it crosses. There are two points in the development of the Rocky Fork to which special attention might be called. It will be noticed that where the present stream leaves the largest of the old valleys partially occupied by it two cols have been crossed, one a minor col between two unimportant tributaries of the old stream, and the other located in the great divide extending through this section in a North and South direction. The most probable sequence of events was the forcing of the water across the first col by the easternmost dam in the old valley, followed by the blocking of the valley's mouth by a still higher one that raised the floods above the second col.

A phenomenon that proved quite deceptive is to be found where Rocky Fork comes into this old valley by way of one of its northern tributaries. Some half mile above the junction of this tributary valley with the old main valley, there is a rock cut with precipitous sides forty to fifty feet high. The hills open out above and below into what are evidently pre-glacial valleys, and it would seem clear that this marks the position of an eroded col. At one point along the gorge considerable masses of the rock have been split apart (by the freezing of water in the

crevices) and the place has local reputation under the name "Falling Rocks." Just over the ridge to the East, in the middle one of the three parallel valleys coming down from the northern part of the county, there is a similar, though less striking, gorge. In a tributary to this gorge is an overhanging rock which has received the title of "Raining Rock," given because of the continual dripping of water from nearly the whole of its under surface. The easternmost of the three valleys has no such escarpments as these that have been mentioned, but its hill sides are dotted with huge boulders of the same sort of country rock, viz., Logan conglomerate. It was at first assumed that these two gorges represent the locations of old cols. From map study Professor Tight questioned very seriously the possibility of there ever having been cols at these places, but after going over the ground with me he admitted that my inferences seemed tenable. If these were old cols of course the valleys above them must have had outlets in some other direction, most probably to the West or Northwest. Thorough examination of the whole basin revealed the fact that it is completely rock bound, the only gaps anywhere near deep enough to have drained the old valleys being at the two points already discussed and at whatever point the present stream comes into the basin of this old system from the Northwest. After a more careful and thorough examination at Falling Rocks it was found that if the old valley were restored at that place so as to leave no rock escarpment visible, that point would still mark the lowest outlet to this section of the valley. And the same was found to be true for the gorge on the Raining Rock tributary. The only way left to account for the gorge-like character at these points is the fact that the outcrop of the conglomerate here is much harder and more resistant than elsewhere along these streams.

The same difficulty was experienced on Rocky Fork as on the Wakatomaka in locating the exact position of the old col. Two or three miles above Falling Rocks the valley becomes narrow and gorge-like (without, however, any very prominent escarpments) and there may have been a col across any one of

several places. The change in character of the valley walls above and below this stretch, as well as the deepening of the rock floor of the valley whichever way one goes from it, leave no doubt that there was at some time a col across it. The position chosen in mapping this col was selected after studying the location of the divide on either side of the stream as indicated by lateral drainage.

As shown on the map, the small pre-glacial valley in which Rocky Fork heads was originally tributary to the North Fork of the Licking. It is to be noted that the glacial deposit at its mouth is too low to have been a factor in the cutting down of the col whose removal has permitted reversal of the drainage in this valley. The old valley floor at and above this moraine is so nearly level that a ditch no more than ten feet deep leading out toward the North Fork would in time pirate a considerable portion of the Rocky Fork's head waters. Indeed up to within a very few years this valley floor has been swamp for a distance of one or two miles and entirely unfit for agricultural purposes. All the county maps that I have seen show it a swamp or lake, and it is not yet sufficiently well drained to withstand a wet season.

Before passing from this part of the subject it would not be out of place to call attention to the eroded col that has been located on the North Fork near the Knox-Licking county line. The work and credit of locating this old col belongs with the unpublished article of Professor Tight to which reference has already been made; but its correlation with the modifications about the head waters of the Old North Fork makes necessary a brief mention of it at least in this connection. It is the easternmost erosion in the East-and-West line of the divide between the Old Mt. Vernon and Old Newark Rivers.

In tramping about over this section of the state many evidences were found of the high water level that must have existed West and North of the great divide before and while its cols were being eroded. In several places glacial debris was found on the tops of cols between minor systems lying entirely within the glaciated region. Such cols being covered by the

comparatively quiet waters of the glacial lake, presented shoals for the stranding of floating icebergs. As one of these would be melted another would be caught, and so gradually the col received its accumulation of boulder clay. Another specially noticeable feature of the region is the sudden change from the broad, shallow valleys with gently sloping hill sides West of the main divide to the deep ravines and abrupt slopes that one finds immediately upon crossing to the eastward. In travelling from Bladensburg toward Coshocton we found first a fine rolling country, excellently adapted to cultivation, which extended up to the very brow of the divide. Then suddenly and without the shadow of a gradation in passing from the one character to the other we found ourselves in the midst of as rough and hilly a region as is to be seen in the state. Of course the valleys have not the depth that is to be observed down nearer the Ohio River, but they are just as numerous and broken, with just as little evidence of any leveling influence due to glaciation.

Although the glacier itself, and probably the great majority of the icebergs, did not extend beyond the barrier of the great divide, there is abundant evidence that the water level of the glacial lake was maintained beyond it for some time. Near the tops of the hills along many of the valleys are to be seen well defined beach marks that can be accounted for in no other way so readily as by supposing that they were formed by the action of the surf before the great cols down the Muskingum and Ohio Rivers had been cut away sufficiently to lower the level of the glacial waters. The reader is not to understand that no glacier worn materials are to be found East of the divide. They exist there in abundance, but very few of them on the tops of the hills, or rather cols, as is the case to the West. Practically all such debris is found in the bottoms of the old valleys where it has been deposited by the water coming from the glaciated region during and after the cutting down of the old cols. After the filling in this way of the main axes of the new drainage systems, the tributaries of these systems would fill in the natural course of events with the sediment from their own drainage.

In conclusion the reader is referred to the map, Plate III., showing the "restored drainage" in the region under review. In comparing the old with the new drainage it is not difficult to see that the former has a much better right than the latter to be described as the NORMAL system. Instead of, as at present, four streams flowing directly across the highest divide in this part of the state, the restoration shows no streams crossing this divide. Secondly, the restored drainage shows that in general the axes of tributaries in any of the systems are parallel, which is as it should be. Again, the old drainage shows uniformity not only in axial directions, but also in the size and shape of its hydrographic basins. In the present drainage these basins are irregular in shape and extent, and in some instances almost inextricably intermingled. This irregularity is particularly evident in the relation of the Wakatomaka basin to those of Owl Creek and Rocky Fork.

It will not be out of place to correlate the work that has been described with that done by Professor Tight in adjacent regions, reference to which has been made several times in the course of the descriptions. In this portion of the state Professor Tight has located the main axes of two quite important pre-glacial streams, to one of which he has given the name "Old Mt. Vernon River" and to the other, "Old Newark River." Both these streams had general southwesterly courses and, in Knox and Licking Counties, the furthest point West at which their valleys are distinctly visible in the topography, approached so near to each other that in the readjustment of drainage due to advance of the glaciers cols have been cut down and the basins of the two streams intermingled. The work of the writer has been to locate the divide between these two old streams and to determine the changes incident to the breaking down of this old divide during glacial times. It is but a small part in the problem of restoring the pre-glacial drainage in the Ohio River basin, but it is presented to those interested in the hope that it is a distinct contribution to that problem. In closing, I wish to express my appreciation of Professor Tight's kindly interest in my work, and of his many suggestions by which I

was enabled to economize both time and labor in the prosecution of field investigations. Work that was taken up originally merely as recreation has proved to be more than recreation in that it has become intensely interesting study as well.

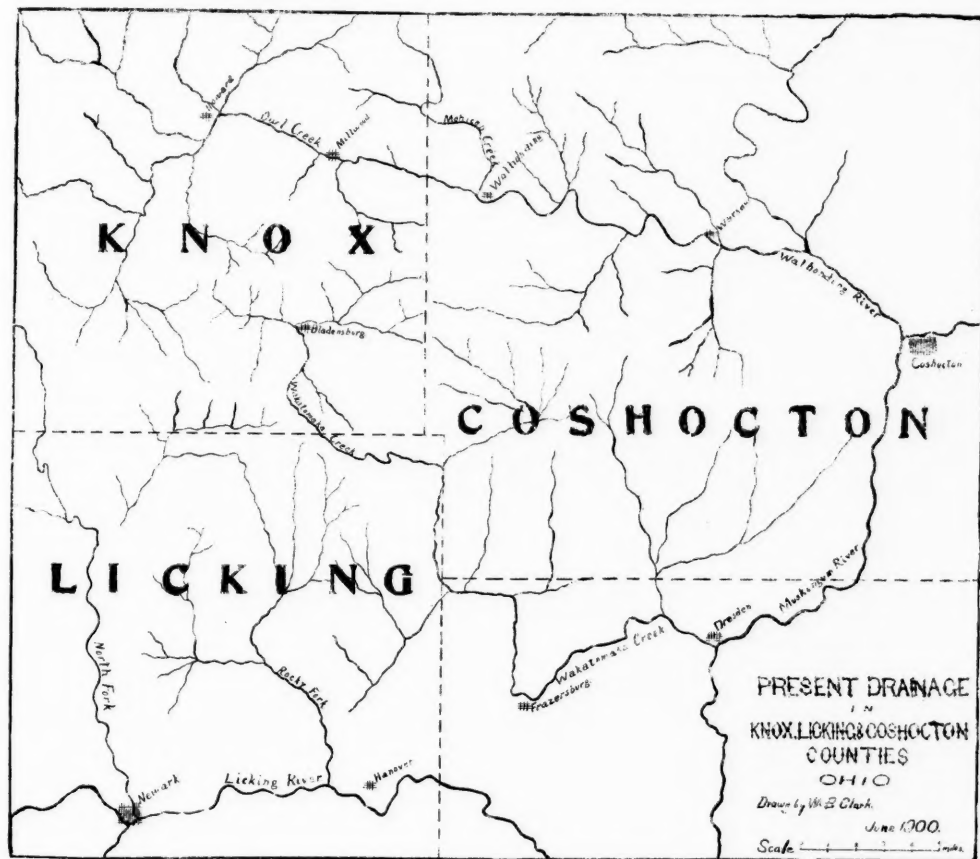
GRANVILLE, OHIO, MAY, 1902.

DESCRIPTION OF THE PLATES.

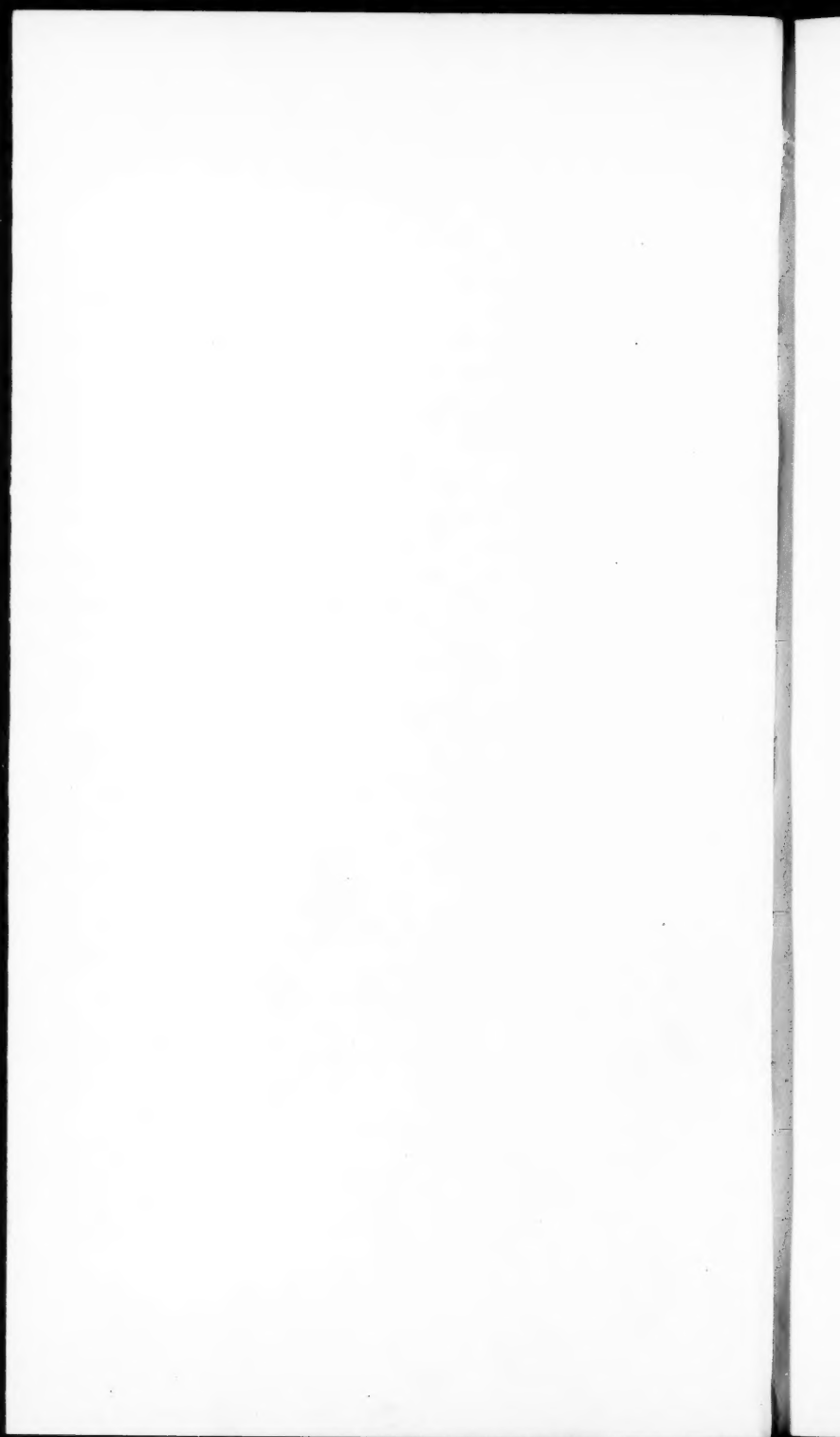
I. A sketched map of the present drainage in parts of Knox, Licking and Coshocton Counties, Ohio. By an oversight the location of Mt. Vernon is not indicated. It is situated near the Northwestern portion of the included region as may be seen by reference to Plate II.

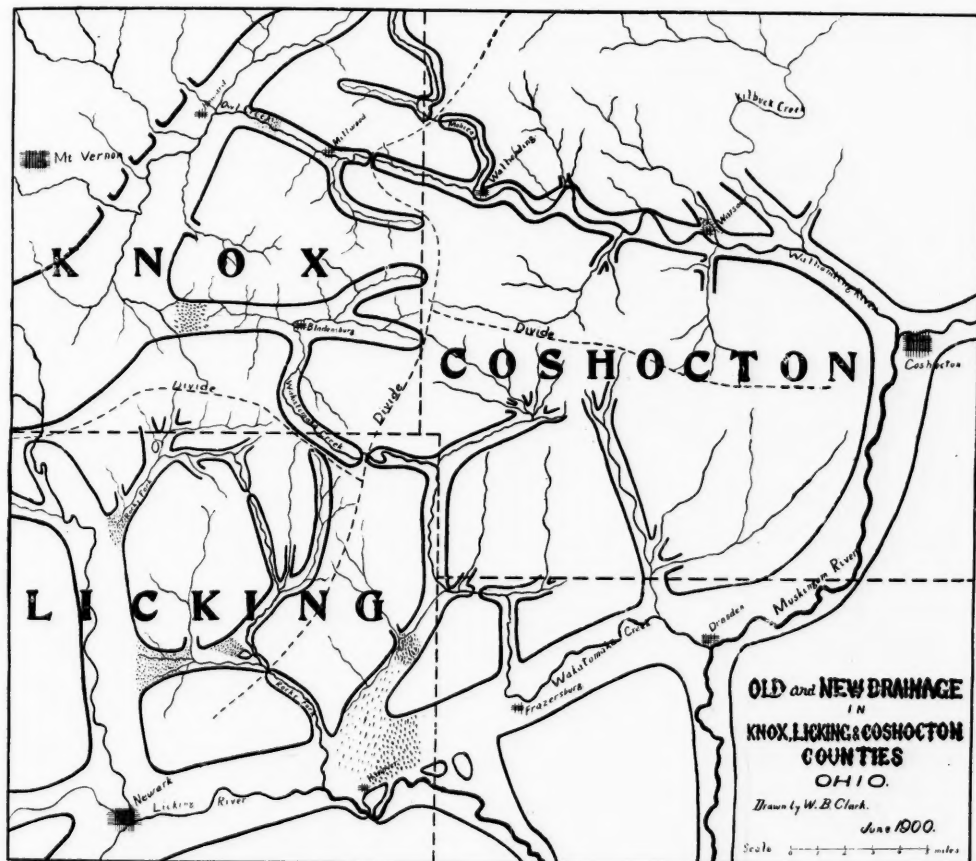
II. This shows the pre-glacial valleys of the same region together with their relation to the present drainage as outlined in Plate I. The heavy lines represent pre-glacial valley walls and are drawn to represent the brow of the hills, not their bases. All these old valleys in the western half of the map are filled with glacial debris as well as those in the eastern half which received water from the glaciated region. Dotted portions represent places where this filling rises above the general level of the surrounding flood plains. The wide valley from Coshocton to Newark is that of the Old Newark River, the one in the northwestern portion of the map, that of the Old Mt. Vernon River.

III. In this map the pre-glacial drainage of the section is shown restored. It needs no special comment other than to call attention to some changes that have been adopted in naming the old streams. What is designated on the map as the Old Muskingum River should be the Old Newark River. Old Knox River should be Old Mt. Vernon River and Old Wakatomaka Creek, Old Hanover Creek.

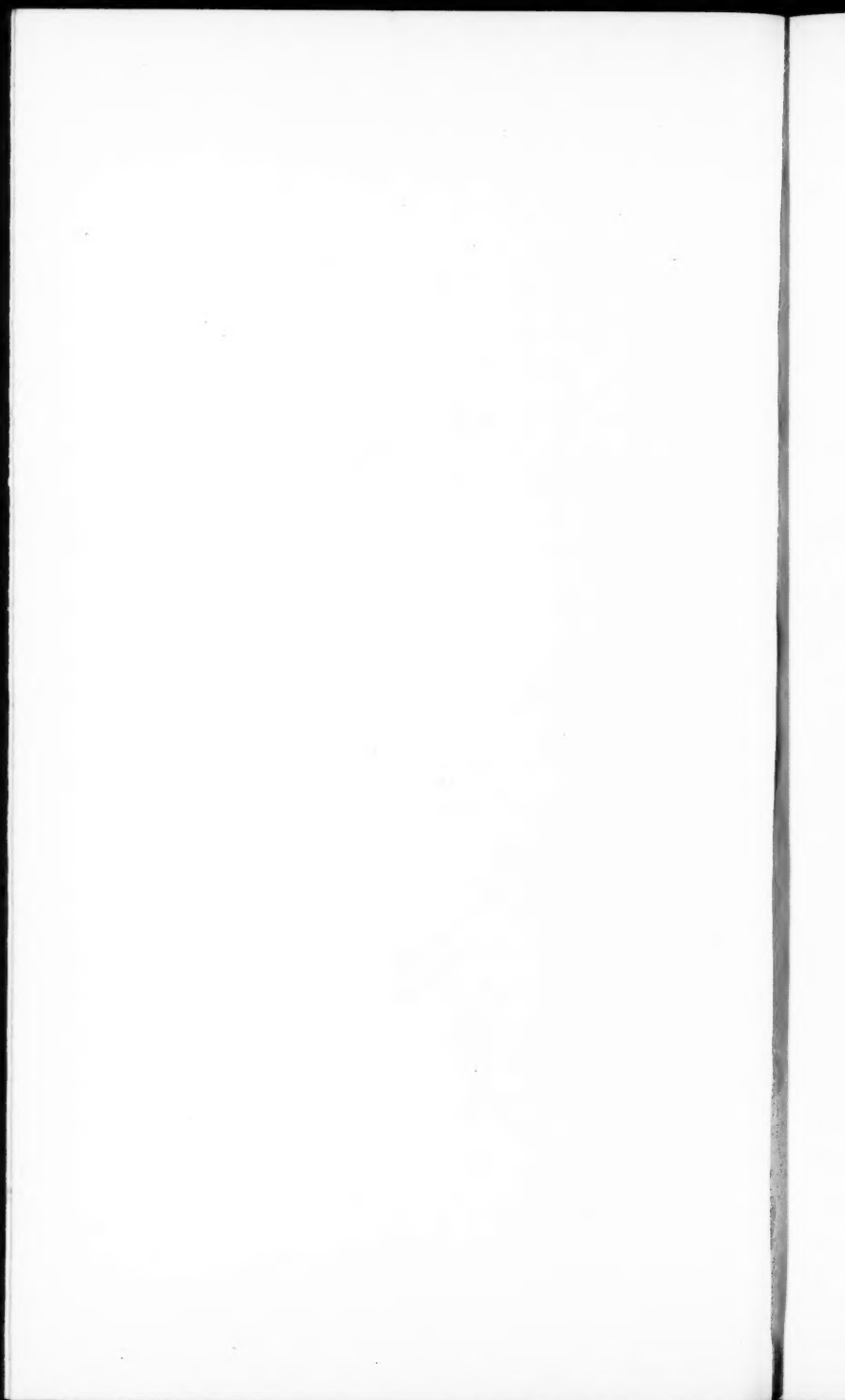


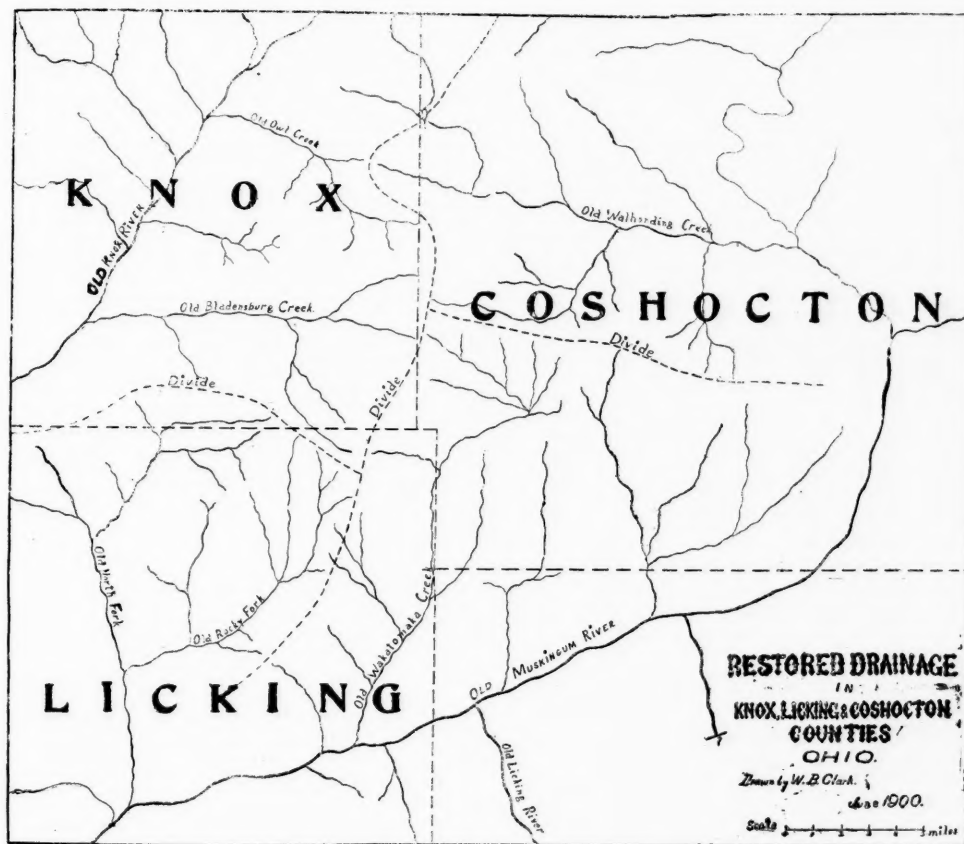
CLARK—Drainage Modifications.





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